

REMARKS/ARGUMENTSStatus of Claims

Claims 13, 15-19, 23-28, 31-38, and 40-44 are being resubmitted. Claims 13, 16, 19, 25, 28, 32, 34-38, 40, 41, and 43 have been amended. Claims 1-12 have been withdrawn as being drawn to a non-elected invention. Claims 14, 20-22, 29, 30, and 39 have been canceled without prejudice or disclaimer of the subject matter.

Claims 16, 19, 22, 25, 34, 35, and 41 were objected to because of informalities. Claims 13-16, 19, 20, 22-24, 26, and 27 were rejected under 35 U.S.C. 102(b) as being anticipated by Brenner et al. (U.S. Patent No. 2,643,221). The Office Action further rejected Claims 36, 37, and 39 under 35 U.S.C. 102(e) as being anticipated by Sturgill et al. (U.S. Patent Application No. 2003/0234063). The Office Action still further rejected Claims 17 and 18 under 35 U.S.C. 103(a) as being unpatentable over Brenner et al. (U.S. Patent No. 2,643,221) in view of Kedward et al. (U.S. Patent No. 4,305,792). The Office Action still further rejected Claim 21 under 35 U.S.C. 103(a) as being unpatentable over Brenner et al. (U.S. Patent No. 2,643,221) in view of Sturgill et al. (U.S. Patent Application No. 2003/0234063). The Office Action still further rejected Claim 25 under 35 U.S.C. 103(a) as being unpatentable over Brenner et al. (U.S. Patent No. 2,643,221) in view of Beebe, Jr. et al. (U.S. Patent No. 3,350,773). The Office Action still further rejected Claims 28-31, and 35 under 35 U.S.C. 103(a) as being unpatentable over Brenner et al. (U.S. Patent No. 2,643,221) in view of Beebe, Jr. et al. (U.S. Patent No. 3,350,773) and Sturgill et al. (U.S. Patent Application No. 2003/0234063). The Office Action still further rejected Claim 32 under 35 U.S.C. 103(a) as being unpatentable over Brenner et al. (U.S. Patent No. 2,643,221) in view of Beebe, Jr. et al. (U.S. Patent No. 3,350,773) and Sturgill et al. (U.S. Patent Application No. 2003/0234063), and

in further view of Du Rose (U.S. Patent No. 3,355,267). The Office Action still further rejected Claim 33 under 35 U.S.C. 103(a) as being unpatentable over Brenner et al. (U.S. Patent No. 2,643,221) in view of Beebe, Jr. et al. (U.S. Patent No. 3,350,773) and Sturgill et al. (U.S. Patent Application No. 2003/0234063), and in further view of Cook, Jr. et al. (U.S. Patent No. 4,100,050). The Office Action still further rejected Claim 34 under 35 U.S.C. 103(a) as being unpatentable over Brenner et al. (U.S. Patent No. 2,643,221) in view of Beebe, Jr. et al. (U.S. Patent No. 3,350,773) and Sturgill et al. (U.S. Patent Application No. 2003/0234063), and in further view of Kedward et al. (U.S. Patent No. 4,305,792). Claim 38 was rejected under 35 U.S.C. 103(a) as being unpatentable over Sturgill et al. (U.S. Patent Application No. 2003/0234063) in view of Brar et al. (U.S. Patent No. 5,240,590). Further rejected was Claim 40 under 35 U.S.C. 103(a) as being unpatentable over Sturgill et al. (U.S. Patent Application No. 2003/0234063) in view of Brenner et al. (U.S. Patent No. 2,643,221). The Office Action still further rejected Claims 41-42, and 44 under 35 U.S.C. 103(a) as being unpatentable over Brenner et al. (U.S. Patent No. 2,643,221) in view of Sturgill et al. (U.S. Patent Application No. 2003/0234063), Brar et al. (U.S. Patent No. 5,240,590), Cook, Jr. et al. (U.S. Patent No. 4,100,050), and Beebe, Jr. et al. (U.S. Patent No. 3,350,773). The Office Action still further rejected Claim 43 under 35 U.S.C. 103(a) as being unpatentable over Brenner et al. (U.S. Patent No. 2,643,221) in view of Sturgill et al. (U.S. Patent Application No. 2003/0234063), Brar et al. (U.S. Patent No. 5,240,590), Cook, Jr. et al. (U.S. Patent No. 4,100,050), and Beebe, Jr. et al. (U.S. Patent No. 3,350,773), and in further view of Du Rose (U.S. Patent No. 3,355,267).

Examiner Interview

A telephone interview was conducted between the Examiner and Applicant's representative. Proposed amendments to the claims were

discussed. Further discussed were the cited references Brenner '221 and Sturgill et al. '063.

No agreement was reached.

Claim Objections

Claims 16, 19, 25, 34, 35, and 41 were amended by replacing "and" with "or" to address the objections based on informalities made in the Office Action. Claims 35 and 41 have further been amended to correct a spelling mistake as requested in the Office Action.

Section 102 Rejections

Brenner et al. (U.S. Patent No. 2,643,221)

Brenner et al. teach electro-deposition of phosphorous-nickel and phosphorous-cobalt alloys. Alloys containing nickel or cobalt and as much as 15% of phosphorous are electro-deposited from solutions containing phosphites. The plating solutions taught by Brenner et al. for electro-deposition of phosphorous-cobalt alloys (Fig. 9, bath 4 and 5), contain cobalt chloride, cobalt as phosphate or phosphite, phosphite (H_3PO_3), and phosphate (H_3PO_4). Brenner et al. found that one of the most important considerations in the successful electrodeposition of the phosphorous alloy is the pH of the plating solutions (Col. 3, lines 10-12). In order to control the pH value within narrow limits, buffers, such as boric or phosphoric acid, are added to the plating solution (Col. 3, lines 24-25). Even with using a buffer, Brenner et al. found that the pH value of high phosphite baths, such as bath 5 in Figure 9, is more critical than that of the low phosphite baths, such as bath 4 in Figure 9, and must be kept between 0.5 and 1.0. Brenner et al. found that it is difficult to obtain

uniformly bright deposits if the pH value is above 1.0 (Col. 4, lines 65-71). Furthermore, Brenner et al. teach electrodepositing of cobalt-phosphorous alloys, see, for example, Col. 1, lines 10-12, Col. 2, lines 20, Col. 5, lines 32-34, but do fail to teach electro-depositing of cobalt-phosphorous-boron alloys.

Contrary to Brenner et al., the present invention teaches a plating bath that enables obtaining a cobalt-phosphorous-boron coating through electroplating (as in Claims 13, 36, and 41, as amended). The plating solution as in Claims 13 and 28, as amended, includes cobalt metal ions as cobalt sulfate, chloride ions form alkali chlorides as sodium chloride, boron as perborate, phosphite as phosphorous acid, and phosphate as phosphoric acid. It was found that the addition of perborate enables to maintain a stable pH value in the range from about 1 to 1.8 without other additions other than the phosphorous acid (phosphite) as well as improving the bright deposition range by producing fine-grained deposits over a wide range of process variables such as current density and temperature (as in Claims 13, 28, 36, and 41 (as amended), and as supported in paragraph [027]). The bright deposition relates to the phosphorous content, which needs to be high (10-15 weight %, as in Claims 13, 36, and 41, as amended) to obtain the desired hardness. The phosphorous content in the deposit can be obtained through a high phosphite content in the plating solution. The phosphite content of the plating solution as in Claims 28 and 41, as amended, may be comparable with the plating bath 5, Figure 9, of Brenner et al. By adding boric acid as a pH buffer to the bath, Brenner et al. are only able to maintain a stable pH value of the bath between 0.5 and 1 and, consequently, do not obtain uniformly bright deposits at pH values above 1 (Figure 9; Col. 4, lines 68-71). Contrary to Brenner et al., the present invention as in Claims 13, 28, and 41 (as amended) adds boron as perborate to the plating solution which, unexpectedly, resulted in obtaining a stable pH value in the range from about 1 to 1.8 and, therefore, in obtaining bright deposits over a range of current densities at a pH of about 1 to 1.8.

Since the obtained brightness relates to the phosphorous content of the deposit and the hardness, it is possible by using the plating solution of the present invention (as in Claims 13, 28, 36, and 41, as amended) to obtain deposits that have a higher phosphorous content and a higher hardness than the deposits obtained using the plating bath, for example, bath 5 in Figure 9, of Brenner et al. Since by introducing perborate to the plating solution (as in Claims 13, 28, 36, and 41, as amended) a stable pH value in the range from about 1 to 1.8 can be obtained for a solution having a high phosphorous content, which is not possible using boric acid as done by Brenner et al., Brenner et al. do not anticipate the present invention as in Claims 13, 28, 36, and 41, as amended, and their dependent claims.

Also, it would not have been obvious to develop the plating solution of the present invention as in Claims 13, 28, 36, and 41, as amended, and their dependent claims, based on the plating baths taught by Brenner et al., since adding perborate as an oxidizer yielded unexpected results and uniformly bright deposits were obtained at a pH value above 1, which is not possible using the plating bath taught by Brenner et al. Furthermore, Brenner et al. use metal chloride, such as cobalt chloride (Figure 9, baths 4 and 5) where the present invention as in Claims 13, 28, and 41, as amended, uses chloride ions from alkali chlorides, such a sodium chloride. As is well known in the art, deposits produced from plating baths containing metal chlorides, such as cobalt chlorides and ammonium chlorides, possess high tensile stresses. By adding sodium chloride to the plating solution (as in Claims 13, 28, and 41, as amended) instead of metal chloride, deposits were obtained that had low tensile to compressive (residual) stresses (as in paragraph [030]). Since this result was unexpected and not foreseeable, Brenner et al. do not anticipate the present invention and it would not have been obvious to develop the plating solution of the present invention based on the teachings of Brenner et al. The deposit residual stress is a significant factor in the overall response of a part in

fatigue loading, an important factor in the aircraft industry. Significant fatigue improvements are typically seen when deposits have low tensile to compressive stresses, which can be obtained by using the plating solution of the present invention (as in Claims 13, 28, and 41, as amended). Consequently, the present invention as in Claims 13, 28, 36 and 41, as amended teaches a plating solution and a method that enable producing hard deposits that have a low (compressive) residual stresses (see also paragraph [030]).

Therefore, Brenner et al. do not anticipate or make obvious the present invention as in Claims 13, 15-19, 23-28, 31-38, and 40-44 (as amended).

Sturgill et al. (U.S. Patent Application No. 2003/0234063)

Sturgill et al. teach conversion coatings based on cobalt. The conversion coating contains a trivalent or tetravalent cobalt/valence stabilizer complex. The term "conversion coating", as used in the finishing industry, refers to the conversion of a metal's surface into a surface that will more easily accept applied coatings and/or provide for a more corrosion resistant surface. These coatings are typically rather thin, quickly and easily formed, and easily scratched. "Conversion coatings grow an oxide coating on the metal without an externally applied electrical potential. The protective film is produced by a chemical redox reaction between the metal surface and the conversion coating solution. The film is composed both of an oxide and integral corrosion inhibitor species formed during exposure to the conversion coating solution (paragraph [0008]." To obtain a cobalt conversion coating the cobalt ions need to be oxidized from a divalent to a trivalent charge state. Oxidizers suitable for the purpose of producing and maintaining the cobalt ion in the trivalent charge state (chemical oxidation) include, for example, perborates (paragraph [0053]). "Oxidation of the cobalt to the trivalent state may also be achieved in the conversion coating solution through electrolytic means. In most instances,

however, this approach may not be economically feasible due to the large energy costs associated with electrolytic oxidation (paragraph [0054])." Therefore, Sturgill et al. either use perborate to oxidize cobalt through chemical oxidation, which is done without an externally applied electrical potential or use electrolytic oxidization, which requires a high energy. Sturgill et al. further teach a process for the application of an optimized cobalt conversion coating (paragraph [0052]). This process includes a step of formation of cobalt conversion coating (paragraph [0771]) besides a plurality of pretreatment processes and post treatment processes. The conversion coating solution is applied through immersion, spray application, fogging, or manual application (paragraph [0772]).

Contrary to Sturgill et al., in the present invention cobalt is not oxidized to a trivalent charge state. The concentration of perborate in the plating solution as in Claims 28 and 41, as amended, is not high enough to cause chemical oxidization and the direct current applied between the surface to be coated and an anode, as in Claims 36 and 41, as amended, is not high enough to cause electrolytic oxidization. Furthermore, while the conversion coating of Sturgill et al. is rather thin and easily scratched, the coatings obtained through the plating process of the present invention as in Claims 36 and 41, as amended, possess sufficient hardness and compressive residual stress properties to meet wear and fatigue requirements, for example, for aircraft wear coatings (paragraph [0030], as in Claim 41, as amended). Still further, while a substrate or part to be coated with a cobalt-phosphorous-boron coating through an electroplating process as in Claims 36 and 41, as amended, of the present invention, is submerged into a plating solution (as in Claims 13, 28, 36, and 41, as amended), the conversion coating solution of Sturgill et al. is applied through immersion, spray application, fogging, or manual application (paragraph [0772]). The cobalt conversion coating of Sturgill et al. is produced in paragraphs [0771], [0772] by a chemical redox reaction between the metal surface and the

conversion coating solution without an externally applied electrical potential. Contrary to Sturgill et al., in the present invention as in Claims 36 and 41, as amended, a direct current is applied between a cathode (substrate to be coated) and an anode. Since the deposits produced by Sturgill et al. and by the present invention as in Claims 13, 28, 36, and 41, as amended, have different mechanical properties and are made for different applications, since conversion coating is a completely different process than electroplating, and since Sturgill et al. do not obtain a cobalt-phosphorous-boron coating as does the present invention (as in Claims 13, 36, and 41, as amended), Sturgill et al. does not anticipate the present invention and it would not have been obvious to develop the plating solution and the plating process of the present invention (Claims 13, 28, 36, and 41, as amended) based on the teachings by Sturgill et al.

While Sturgill et al. use perborate to oxidize cobalt in a cobalt conversion coating process, Brenner et al. add boric or phosphoric acid to the plating solution used during electro-deposition of phosphorous-cobalt alloys. The purpose of the boric acid is to act as a buffer in order to control the pH Value of the plating solution within narrow limits. Since oxidization of cobalt is not a needed or desired step for an electro-plating process, it would not have been obvious to use the perborate of Sturgill et al. in the plating solution of Brenner et al. as a replacement for the boric acid. Furthermore, the cobalt conversion coating process of Sturgill et al., where an oxide coating is grown on a metal surface without an externally applied electrical potential, is a completely different process than the electro-plating process of Brenner et al., where alloys containing nickel or cobalt and phosphorous are electro-deposited from solutions containing phosphites. Consequently, it would not have been obvious to combine the teachings of Sturgill et al. with the teachings of Brenner et al. to achieve the the plating solution and the plating process of the present invention (Claims 13, 28, 36, and 41, as amended).

Therefore, Sturgill et al. do not anticipate or make obvious the present invention as in Claims 13, 15-19, 23-28, 31-38, and 40-44 (as amended) either alone or with the other references of record.

Section 103(a) Rejections

Kedward et al. (U.S. Patent No. 4,305,792)

Kedward et al. teach a process and apparatus for coating an article with a layer of metal incorporating particles. The process may be electroless or electrolytic. In one example, a stainless steel panel is provided with a composite coating comprising a cobalt matrix including particles of chromium carbide. The plating solution includes cobalt sulfate, boric acid, and sodium chloride. Cobalt chips contained in titanium baskets surrounded by anode bags are used as anodes (Col. 4, lines 22-33).

Contrary to Kedward et al., who use the cobalt chips as an anode and cobalt sulfate as a source of cobalt metal ions, the present invention as in Claims 13 (as amended), 17, and 18 utilizes cobalt chips or balls submerged into the plating solution as the source of cobalt metal ions. Also, Kedward et al. electrodeposit a cobalt matrix including chromium carbides, whereas the present invention (as in Claims 13 (as amended), 17, 18, and 34 (as amended)) electrodeposits a cobalt-phosphorous-boron coating. Therefore, it would not have been obvious to apply the teachings of Kedward et al. to the present invention as in Claims 13 (as amended), 17, 18, and 34 (as amended). Since Brenner et al. use cobalt chloride and cobalt as phosphate or phosphite as a cobalt source in the plating baths 4 and 5, Figure 9, it would not have been obvious to combine the teachings of Brenner et al. and Kedward et al. to obtain the plating bath of the present invention as in Claims 13 (as amended), 17, 18, and 34 (as amended). Also, since Brenner et al. electrodeposit alloys

containing cobalt and phosphorous from solutions containing phosphites (Col. 1, lines 10-12) while Kedward et al. do not include phosphites in their plating solution it would not have been obvious to combine those two references.

Therefore, Kedward et al. do not anticipate or make obvious the present invention as in Claims 13, (as amended), 17, 18, and 34 (as amended) either alone or with the other references of record.

Beebe, Jr. et al.

Beebe, Jr. et al. teach a method for making bearings. The method taught by Beebe, Jr. et al. includes a plating step, wherein a plating of cobalt-phosphorous is applied to a surface (Col. 4, lines 2-5). The plating of cobalt is achieved by conventional electrolytic means or alternatively by catalytic surface deposition producing a cobalt-phosphorous coating. Electrolytic deposited cobalt can be achieved with well-known techniques employing an aqueous acid solution containing, for example, cobalt sulfate, sodium chloride, and boric acid. The plating solution has a pH value of about 5.2 and a temperature of about 75 °F. A current density of about 40 amperes per square foot is required for depositing cobalt plating (Col. 4, lines 17-34). Another plating solution is used by Beebe, Jr. et al. for plating of cobalt-phosphorous and includes cobalt chloride, sodium hydrophosphite, ammonium chloride, and sodium citrate, the solution having a pH Value of about 8 to 9 and a temperature of about 195 °F (Col. 4, lines 35-44). The plating of cobalt or cobalt-phosphorous on the face of a steel backing strip to be bonded to an aluminum or aluminum-based alloy strip provides an improvement in the strength of the bond formed.

Contrary to Beebe, Jr. et al., the present invention as in Claims 13, 28, 36, and 41 (as amended) and as in their dependent Claims (as amended) teaches a plating solution that includes cobalt sulfate, sodium chloride,

perborate, phosphite (phosphorous acid) and phosphate (phosphoric acid). The plating solution of the present invention has a pH value of about 1 to 1.8, while the cobalt-phosphorous plating solution of Beebe, Jr. et al. has a pH value in the range of about 8 to 9. Since the pH value of the bath is critical for the phosphorous content and the mechanical properties of the deposits, the coatings produced using the plating solution of the present invention as in Claims 13, 28, 36, and 41 (as amended) have different material properties (high hardness and low compressive residual stress properties) than the cobalt-phosphorous deposits of Beebe, Jr. et al. that enhance the bond between a steel backing and an aluminum or aluminum-base alloy. Since neither Brenner et al. nor Beebe, Jr. et al. obtain a cobalt-phosphorous-boron coating, as does the present invention (as in Claims 13, 28, 36, and 41 (as amended)), it would not have been obvious to combine the teachings of Brenner et al. with the teachings of Beebe, Jr. et al. to achieve the teachings of the present invention. This is also true, since neither Brenner et al. nor Beebe, Jr. et al. use sodium chloride or perborate as does the present invention as in Claims 13, 28, 36, and 41 (as amended)).

Therefore, Beebe, Jr. et al. do not anticipate or make obvious the present invention as in Claims 13, 28, 36, and 41 (as amended) and as in their dependent Claims (as amended) either alone or with the other references of record.

Du Rose (U.S. Patent No. 3,355,267)

Du Rose teaches nickel-electroplating baths to obtain a composite coating of three firmly bonded layers of nickel deposits bonded to a nickel substrate (Col. 1, lines 12-14). Where cobalt is desired as an alloying constituent in the deposited nickel layers, the baths may be adjusted by adding cobalt salts, such as cobalt chloride, or cobalt sulfate (Col. 6, lines 53-58). The

temperature of the nickel-electroplating baths is in the range of about 50°F to 180 °F.

The present invention as in Claims 13, 28, 36, and 41 (as amended) and as in their dependent Claims (as amended) teaches plating solutions that contrary to Du Rose do not contain nickel. The plating solution of the present invention may be used to obtain a cobalt-phosphorous-boron coating (as in Claims 13, 36, and 41, as amended), while Du Rose obtains nickel and nickel-phosphorous coatings. Since nickel and nickel-phosphorous deposits have different material characteristics than cobalt-phosphorous deposits, one cannot apply the conditions of a nickel-phosphorous plating bath, such as temperature or pH value, to a cobalt-phosphorous plating bath. Consequently, it would not be possible to apply the teachings of Du Rose to the teachings of Brenner et al., Beebe, Jr. et al., and Sturgill et al. to accomplish the plating solution and the cobalt-phosphorous-boron coating of the present invention (as in Claims 13, 36, and 41, as amended).

Therefore, Du Rose does not anticipate or make obvious the present invention as in Claims 13, 28, 36, and 41 (as amended) and as in their dependent Claims (as amended) either alone or with the other references of record.

Cook, Jr. et al. (U.S. Patent No. 4,100,050)

Cook, Jr. et al. teach an improved anode structure for a chlor-alkali type diaphragm cell. The anode is a porous valve metal, e.g., titanium, has on one side a coating of a noble metal or a noble metal oxide and on the uncoated side a membrane composed of a cation-active permselective material (abstract).

While Cook, Jr. et al. disclose an advanced anode for a diaphragm cell,

the present invention as in Claims 33, 36, and 41 (as amended) uses an anode typically used for plating processes, such as a platinized metal anode. Since the anode taught by Cook, Jr. et al. is made out of porous valve metal, it cannot be used for electroplating processes. Therefore, the anode taught by Cook, Jr. et al. could not be used for electroplating as done by Brenner et al., Beebe, Jr. et al., and Sturgill et al.

Therefore, Cook, Jr. et al. do not anticipate or make obvious the present invention as in Claims 13, 28, 36, and 41 (as amended) and as in their dependent Claims (as amended) either alone or with the other references of record.

Brar et al. (U.S. Patent No. 5,240,590)

Brar et al. teach a process for forming a bearing surface on an aluminum alloy article. The preparation of the surface includes shot peening, which is a mechanical treatment where a surface is blasted with steel balls or abrasive type particles (Col. 2, lines 47-67). The mechanical surface treatment introduces beneficial compressive stresses at and immediately adjacent to the surface (Col. 3, lines 18-21).

While the present invention as in Claims 38 and 41, as amended, uses dry abrasive blast for cleaning of a surface, the intensity of the blast is adjusted such that the surface is only cleaned and not mechanically treated to increase the density and to reduce the porosity of the surface, as done by Brar et al. (Col. 3, lines 10-13). Since Sturgill et al. do teach a conversion coating process and not an electroplating process, as does the present invention (as in Claims 36 and 41, as amended), it would not have been obvious to combine the teachings of Brar et al. and Sturgill et al. to obtain the plating process of the present invention as in Claims 36 and 41, as amended.

Therefore, Brar et al. do not anticipate or make obvious the present invention as in Claims 36 and 41 (as amended) and as in their dependent Claims (as amended) either alone or with the other references of record.

CONCLUSION

Applicant would like to thank the Examiner for the telephone interview of December 12, 2005.

Reconsideration and withdrawal of the Office Action with respect to Claims 13, 15-19, 23-28, 31-38, and 40-44 is respectfully requested. It is believed that Claims 13, 15-19, 23-28, 31-38, and 40-44 are now in condition for allowance. Applicant respectfully requests that a timely Notice of Allowance be issued in this case.

In the event the examiner wishes to discuss any aspect of this response, please contact the attorney at the telephone number identified below.

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